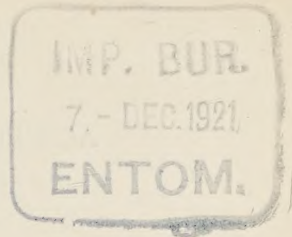


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University of Maine



Maine Agricultural Experiment Station

ORONO

BULLETIN 296

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ORTHOPTERA OF MAINE.

Grasshoppers and Related Insects.

The Table of Contents for this Bulletin is given on page 36.

MAINE

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ORONO, MAINE

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BULLETIN 296

ORTHOPTERA OF MAINE.¹

BY ALBERT P. MORSE.²

INTRODUCTION.

Grasshoppers and crickets, together with certain less common forms such as cockroaches, walkingsticks and earwigs, are classed together in a major group or *order* of insects termed the Orthoptera.³

This is one of the most important of all groups of insects in its economic relations to man, a large number of the species being highly destructive to his crops; some, in fact, are literally scourges of the earth; others enter his dwellings and pollute or destroy his food. Not a year passes but severe damage is done by them in this State; though this is often of such a nature as to be unnoticed or attributed to other causes. Shortage of feed in pastures is more likely to be laid to drought than to the insects which have eaten it.

Consequently it is necessary to consider these creatures as factors to be dealt with in successful agriculture, and wise to secure and impart information about them to those most vitally concerned—the farmers of the State—whose welfare depends in larger measure than even they themselves are aware, on an adequate knowledge of the habits, life histories, and methods of control of these insects.

LIST OF FAMILIES.

The order Orthoptera as found in Maine contains representatives of six groups of lesser rank called *families*, as follows:

¹Papers from the Maine Agricultural Experiment Station: Entomology No. 104.

²Member of Station Summer Staff.

³From two Greek words signifying "straight" and "wings." The under wings of the Orthoptera fold, like a fan, in straight lines. See Figure 1.

I. ACRIDIDAE⁴,—grasshoppers with short antennae⁵, the common grasshoppers of our fields and roadsides. (Fig. 1)



FIG. 1. Carolina Grasshopper (*Dissosteira carolina*) or "flying grasshopper." Wing and wing-cover of right side spread. (After Lugger) The hair-line at the side indicates the true length of the body.

2. TETTIGONIIDAE (Locustidae of the older authors),—grasshoppers with long antennae—true grasshoppers, coneheads, katydids, and cave-crickets. (Fig. 2)

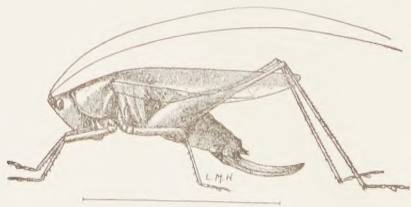


FIG. 2. Common Meadow-grasshopper (*Orchelimum vulgare*). Female, showing blade-like ovipositor. (After Lugger)

⁴See footnote on page 26.

⁵The antennae are the so-called "feelers," two slender, jointed appendages, attached to the head near the eyes.

3. GRYLLIDAE,—crickets, including the ground or field-cricket, climbing or tree-crickets, and burrowing or mole-crickets. (Fig. 3)



FIG. 3. Common Field-cricket (*Gryllus assimilis*). Female, showing needle-like ovipositor. (After Lugger)

FIG. 4. Northern Walkingstick (*Diaperomera femorata*). Male. (After Lugger)

The members of these three families have enlarged hind legs adapted for leaping and are hence called the saltatorial Orthoptera or simply the Saltatoria.

As will be seen above, the term "grasshopper" is applied to insects belonging to two quite different families: the true grasshoppers with long antennae, and the related family with short antennae.

4. PHASMIDAE,—walkingsticks—very slender, greatly elongated, twig-like insects. Only one species in Maine. (Fig. 4)

5. BLATTIDAE,—cockroaches—greatly flattened (depressed), secretive, nocturnal insects, most widely known as pests in dwellings and shops. (Fig. 5)

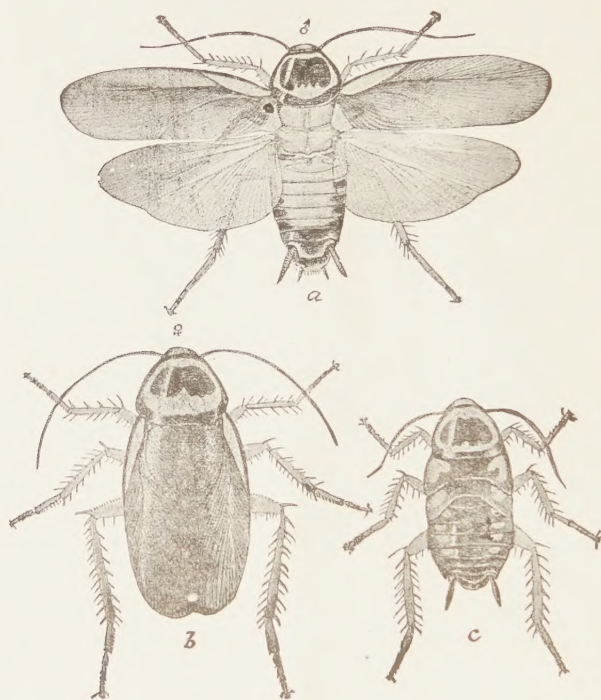


FIG. 5. Australian Cockroach (*Periplaneta australasiae*). Male, female, and last stage of young. (After Marlatt)

6. FORFICULIDAE,—earwigs—Orthoptera with a pair of horny pincers at the end of the body and complicated method of folding the wings. Only two species in Maine. (Fig. 6)

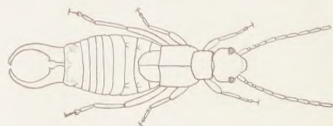


FIG. 6. European Earwig (*Forficula auricularia*). Outline drawing of male, showing form with short forceps; in another form they are at least twice as long. (A. P. M. del.)

CHARACTERS OF THE ORDER.

The characters in which these insects agree and on which this classification is based are as follows:—1st, mouthparts fitted for biting and chewing; 2nd, wings four in number, the hind pair membranous, folded in fan-like plaits, the front pair narrower, stiff, unfolded, covering and protecting the hind pair when at rest; 3rd, life history comprising three stages—egg, young (larva or “nymph”) and adult.

The wings are acquired by degrees during the early life of the insect and become usable as organs of flight only after maturity is reached; at which time also, in the males of many species, the wing-covers become fitted to produce sound and the various species make a wide variety of rattling, chirping, and scraping noises. These sounds are of use primarily as a means of communication either when flying or at rest, or both, especially during the mating period of life. After pairing, and laying the eggs containing the next generation, the adult insects soon die.

EGG-LAYING.

The eggs of short-horned grasshoppers and field-cricket are usually laid in the ground; of long-horned grasshoppers and katydids on or in the stems and leaves of plants. Those of cockroaches are enclosed in a horny capsule which may be carried about for several days protruding from the body of the female but is finally dropped and the young escape but are frequently attended by the parents.

When about to lay in the ground, the female selects a suitable place, usually in firm but not hard soil, and standing nearly erect, forces the end of her abdomen into the soil, opening in it by means of the four horny tips (ovipositor) at the end of the body (Fig. 18) a cavity an inch or two in depth in which the eggs are laid, surrounded by a gummy secretion which soon hardens into a protective envelope. Here they remain until the following warm season, when the young insects hatch and make their way to the surface of the ground. This is the usual course of events.

The eggs of a very few species, laid early in the season, hatch soon after and the young pass the winter in a half-grown

state, maturing early in the spring; a few other species hibernate as adults.

CHARACTERISTICS OF THE YOUNG.

Young grasshoppers are usually recognized at once by their general resemblance to the adults, though lacking wings; that is to say, they have the same general form, with large hind legs which enable them to leap suddenly to some distance; and on the under side of the head, which is much larger in proportion to the body than in the mature insect, the chewing jaws are readily seen.⁶

DEVELOPMENT OF THE YOUNG.

The young grasshopper or cricket acquires the adult form and structure by a series of steps or stages, six in number, which are recognizable with a little trouble by the degree of development of the wings. (Fig. 7)

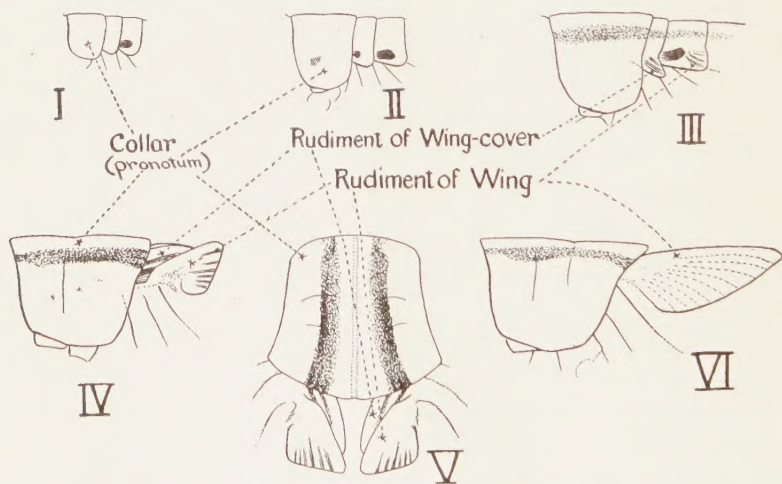


FIG. 7. Development of Wings in young Two-striped Grasshopper (*Melanoplus bivittatus*). I. First stage, from left side (head of insect to left). II. Second stage. III. Third stage. IV. Fourth stage. V. Fourth stage from above (head up). VI. Fifth stage, from left side. Much enlarged, all drawn to same scale. (Original)

⁶Sucking insects which leap freely and are found in the same places may be distinguished from grasshoppers by the slender tube or beak on the under side of the head, sometimes extending between the bases of the front legs.

When the young grasshopper escapes from the egg no sign of wings is to be seen. These become more and more evident with each successive molt or shedding of the skin, which takes place between the different stages of development. If a young or an adult grasshopper be examined there will be seen, just behind the head, a large collar or neckpiece (pronotum) which covers the upper (dorsal) part of its body (prothorax) at that point. Following this collar are the two remaining dorsal parts of the chest or thorax (mesonotum and metanotum) in the shape of half rings partly hidden by the collar (in the adult covered by the wings).

1. In the first stage of the young, that is, the little creature as it hatches from the egg, the lower, hinder angles of these two half segments are not at all prolonged downward and backward (See Fig. 7 I) but they will by degrees take on the structure and function of wings.

2. In the second stage their lower hinder portions are slightly enlarged and project a very little. (Fig. 7 II)

3. In the third stage the change in form of these rudiments is very evident (Fig. 7 III) the anterior one (which will become the wing-cover) is quite angular, the posterior one (which will become the wing) is enlarged, projects, and bears ridges on its surface. They remain, however, in their original relative position to each other.

4. At the molt between the third and fourth stages a remarkable change in the position of the wing-rudiments takes place (Fig. 7 IV). They are both turned upward⁷ instead of downward, and the rudiment of the wing-cover (now long and narrow in shape) lies between the somewhat triangular rudiment of the wing and the body. (Fig. 7 V)

5. In the fifth stage they are in the same relative position as in the fourth, the triangular wings lying outside of the narrow wing-covers, but both pairs are much larger in size, equaling or exceeding the pronotum in length. (Fig. 7 VI)

6. The sixth or adult stage is marked by the acquisition of fully developed, thin, membranous wings, folded longitudinally in fan-like plaits and lying next to the body when at rest, cov-

⁷In this position they are less likely to interfere with the free movement of the insect when crawling through the grass, etc.

ered and protected by the long, narrow, stiff wing-covers (tegmina). With these organs fully developed, the insect is able to fly as well as to crawl and leap.⁸ It soon becomes sexually mature and provides for the perpetuation of its kind.

FOOD AND FEEDING-HABITS.

Grasshoppers and crickets are voracious creatures, growing rapidly to a relatively large size for insects (the house-fly is regarded as about the average), and consuming perforce a large amount of food in the process. This consists, with the majority of species, of plant tissue, especially the leaves of grasses, herbage generally, and even trees. Young apple-trees set in grass-land are especially liable to attack, both young and full-grown grasshoppers climbing up into them from the grass and completely stripping them of their leaves.

Nearly all species devour the dead bodies of their own kind, or of other insects, on occasion, but the tree-crickets are believed to confine their diet to plantlice and are, perhaps, in consequence equally as useful as injurious. The walkingstick is a vegetarian and has been known to strip large areas of woodland in other States. Cockroaches (introduced species only) are often serious pests in houses, restaurants, etc., where they are responsible for the loss of large amounts of food-stuffs; and in conservatories they sometimes cause great damage by nibbling the tender, growing parts of valuable plants.

CHIEF TYPES OF INJURY CAUSED BY ORTHOPTERA.

Indoors

Foodstuffs	Cockroaches, (4 species)
Clothing	European House-cricket
Conservatory plants	Asiatic Cave-cricket
Obnoxious presence	European Earwig

Out-doors

Forests

Hardwoods, leaves of	Walkingstick
Conifers (Pine, Larch)	Pine-tree Grasshopper

⁸This is the normal course of events. There are several species, however, whose wings become aborted during development and never are capable of flight.

Wild Fruit

Cranberries, Blueberries	Bush-katydids, various Long-horned Grasshoppers and Short-horned Grasshoppers
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Orchard trees and small-fruit shrubbery

Mechanical injury and introduction of disease spores	Tree-cricket
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Defoliation	Short-horned Grasshoppers destructive in gardens, etc.
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Field and Garden Crops

Strawberries, Peas, etc.	Field-cricket
Peas, Beans, Potatoes (leaves of), also	Short-horned Grasshoppers (10 species), Long-horned Grasshoppers (4 species), Crickets (2 species) as follows:
Grain, Grass	

SPECIES CHIEFLY RESPONSIBLE FOR INJURY TO FIELD CROPS.

Acrididae,—Short-horned or common "Grasshoppers."

¹⁰ Meadow Slantfaced Grasshopper	<i>Chorthippus curtipennis</i>
¹⁰ Pasture Grasshopper	<i>Orphulella speciosa</i>
⁹ Clear-winged Grasshopper	<i>Camnula pellucida</i>
¹¹ Dusky Grasshopper	<i>Encoptolophus sordidus</i>
¹¹ Green-striped Grasshopper	<i>Chortophaga viridifasciata</i>
⁹ Two-striped Grasshopper	<i>Melanoplus bivittatus</i>
⁹ Lesser Grasshopper	" <i>atlantis</i>
⁹ Red-legged Grasshopper	" <i>femur-rubrum</i>
¹¹ Little Grasshopper	" <i>confusus</i>
¹¹ Northern Grasshopper	" <i>borealis</i>

Tettigoniidae,—Long-horned Grasshoppers.

¹⁰ Short-winged Meadow-grasshopper	<i>Conocephalus brevipennis</i>
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⁹Dangerous pests.¹⁰Often present in injurious numbers but seldom cause severe damage.¹¹Occasionally abundant enough to cause local injury.

¹⁰ Slender Meadow-grasshopper	"	<i>fasciatus</i>
¹¹ Common Meadow-grasshopper	<i>Orchelimum</i>	<i>vulgare</i>
¹¹ Bruner's Meadow-grasshopper	"	<i>gladiator</i>

Gryllidae,—Crickets.

¹⁰ Large Field-cricket	<i>Gryllus</i>	<i>assimilis</i>
¹⁰ Striped Grass-cricket	<i>Nemobius</i>	<i>fasciatus</i>

Since grasshoppers and crickets exist in countless numbers in our fields the aggregate amount of plant tissue consumed by them is enormous. Under normal conditions in Maine their depredations in grasslands are scarcely noticed unless special crops or limited areas are attacked. When the growth of vegetation is below normal, however, or a series of years especially favorable to the multiplication of the insects occurs (usually droughty ones), they become pests of the first magnitude if neglected, and destroy largely or wholly the field and garden crops in affected districts. Several outbreaks have occurred in the early history of the State.

PREVENTION OF INJURY.

The satisfactory solution of the problem lies in the *early detection* of the *likelihood of injury* coupled with *immediate application of measures to prevent it*.

At hatching-time, which in Maine is in late May or early June (or even so late as July in some backward soils and cool exposures), a sharp watch should be kept in infested fields, particularly in their drier, more sandy portions, and similar undisturbed soil in the vicinity, and an estimate formed of the number of insects present per square yard. (See Table 1) If their numbers threaten serious injury, *act at once*, before the enemy has gained strength, by applying the poisoned bran mash and killing the grasshoppers before they have done much damage. The younger they are, the more easily killed. If necessary, repeat the treatment later.

<i>Formula:</i>	Bran.....	20 lbs.
	Paris green (or white arsenic powder).....	1 lb.
	Syrup (common glucose syrup).....	2 qts.
	Amyl acetate (oil of banana).....	1/2 oz.
	Water	3 1/2 gallons

(Caution: Do not add water until the day the mash is to be used).

Preparation: Mix thoroughly the bran and Paris green or finely powdered white arsenic while dry, in a wash tub. Dissolve the syrup in the water and add the amyl acetate. Wet the bran and poison with the mixture, stirring at the same time so as to dampen the mash thoroughly. The bait when flavored with "oil of banana" has been reported by some to be more appetizing, and thus to be eaten by more of the grasshoppers. Some report as good results without molasses or other syrup as with it.

Distribution: The damp mash or bait should be sown broadcast in the infested areas early in the morning, at the time the grasshoppers are beginning to move about from their night's rest. It should be scattered in such a manner as to cover five acres with the amount of bait made by using the quantities of ingredients given in the formula. Since very little of the bran mash is eaten after it becomes dry, scattering it broadcast in the morning, and very thinly, places it where the largest number will find it in the shortest time. Sowing it in this manner also lessens the danger to birds, barnyard fowl, or live-stock of securing a sufficient amount of the poison to kill them. Inasmuch as the poisoned bait does not act quickly, it will be from two to four days before the grasshoppers are found dead, and these will be more numerous in the sheltered places. It does not require much of the poison to kill them. Even a small portion from one of the poisoned flakes will be sufficient to cause death

TABLE 1.

SCALE OF NUMBERS PER SQUARE YARD WITH REFERENCE TO NEED
OF POISONING.

Very Young (e. g., 2nd Stage)			
	Negligible	Harmful	Poison!
A. Large species (<i>Mel. bivitt.</i>)	20	40	100
B. Medium species (<i>Mel. atlanis</i>)	50	100	200
Half-grown.			
A. Large species	10	20	50
B. Medium species	25	50	100
Adult.			
A. Large species	5	10	25
B. Medium species	10	25	50

Allow 10% either way for unknown factors, unseen examples, etc., and give benefit of doubt.

Rank as A: *Gryllus*, *Piscessteira*, etc.

" " B: *Camnula*, *Mel. femur-rubrum*, *Ch. viridifasciata*, etc

" C: *O. speciosa*, *Ch. curtipennis*, *Nemob. fasciatus* and scale at double the figures for B; they are injurious but not serious pests.

But six species of grasshoppers and two of crickets inhabiting Maine are likely to cause serious injury. These are the Lesser Migratory Grasshopper, (*Melanoplus atlanis*); Red-legged Grasshopper, (*Melanoplus femur-rubrum*); Two-striped Grasshopper, (*Melanoplus bivittatus*); Clear-winged Grasshopper, (*Camnula pellucida*); Pasture Grasshopper, (*Orphulella speciosa*); Meadow Slant-faced Grasshopper, (*Chorthippus curtipennis*); Large Black Field-cricket, (*Gryllus assimilis*); Striped Grass-cricket, (*Nemobius fasciatus*).

The remedy and treatment advised is the same for all, but it is always desirable to know which kinds are concerned in an outbreak. Specimens may be killed in denatured alcohol, placed in a vial with a small amount of alcohol and held in place with a wad of cotton, and sent to the Experiment Station for identification. And the following "Key to Aid in Identifying the Young" will be found a practical guide by anyone with a little patience and the faculty of observation.

KEY TO AID IN IDENTIFYING THE YOUNG OF THE MOST COMMON
AND DESTRUCTIVE SPECIES OF ORTHOPTERA FOUND IN GRASSY
FIELDS OR GARDENS IN JUNE AND JULY.

(The characters used in this Key are presented by the majority of individuals of the species. Exceptions occur but may usually be determined by comparison. A magnifying glass enlarging 5 to 10 times will be found helpful.)

- A. Antennae ("feelers" on the head) very slender and tapering to a fine point (usually much longer than the body).
- B. Color black or dark brown. Body a little depressed (flattened from above downward). Feet (tarsi=last segment of leg) three-jointedField-cricket
- C. First joint of hind tarsi with stiff spines above. (Fig. 3)
Large Black Field-cricket, *Gryllus assimilis*
- CC. Without such spines.....Striped Grass-cricket
Small Brown Field-cricket, *Nemobius fasciatus*.
- BB. Color pale green, usually with a dark stripe along middle of back. Feet four-jointed. (Fig. 2) Green, Long-horned or Meadow-grasshoppers.
- AA. Antennae shorter than the body, thread-like but not tapering to a fine point. Feet three-jointed.
Common Grasshoppers (short-horned).
- D. Face in side view strongly retreating, making a sharp angle with the top of the head (vertex). (Fig. 8) Collar (pronotum) nearly flat above, its upper surface (disk) meeting the side at an angle marked by a slight ridge (lateral carina). (Fig. 11)
Slant-faced Grasshoppers.

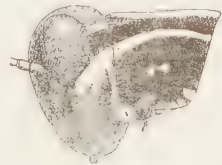
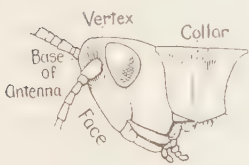


FIG. 8. Side of head and collar (pronotum) of young Slant-faced Grasshopper (*Chorthippus curtipennis*) to show angulation of face with top of forehead (vertex). Enlarged. (Original)

FIG. 9. Top of head and collar of young Slant-faced Grasshopper (*Chorthippus curtipennis*) to show impressed lines (foveolae) on vertex. Enlarged. (Original)

FIG. 10. Side of head and pronotum of young (3rd stage) Red-legged Grasshopper (*Melanoplus femur-rubrum*) showing rounded vertex and characteristic pattern of marking. Enlarged. (Original)

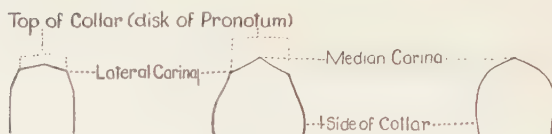


FIG. 11. Section through pronotum of young (3rd stage) Slant-faced Grasshopper (*Chorthippus curtipennis*). Enlarged. (Original)

FIG. 12. Section through pronotum of young Clear-winged Grasshopper (*Camnula pellucida*). Enlarged. (Original)

FIG. 13. Section through pronotum of young Red-legged Grasshopper (*Melanoplus femur-rubrum*), lateral carina absent. Enlarged. (Original)

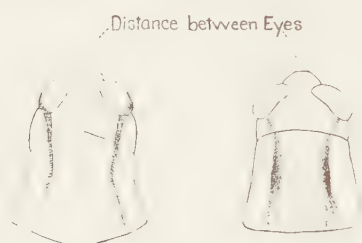


FIG. 14. Top of head and pronotum of young (3rd stage) Clear-winged Grasshopper, showing width between eyes.

FIG. 15. Top of head and pronotum of young (3rd stage) Two-striped Grasshopper (*Melanoplus bivittatus*). Compare with Fig. 14.



FIG. 16. Left hind leg of young (3rd stage) Lesser Grasshopper (*Melanoplus atlantis*) showing parts and oblique banding. Enlarged. (Original)

FIG. 17. Left hind thigh of young (3rd stage) Red-legged Grasshopper (*Melanoplus femur-rubrum*) showing pattern. Compare with Fig. 16. Enlarged. (Original)

- E. Very pale brown or gray in the early stages, often greenish in the later, with a *darker brown stripe* running backward from the eye along the side of the body, covering the upper half of the thorax and fading out ventrally along the side of the abdomen. (This

dark stripe is very characteristic in the first three stages; in the later ones it is often faint or absent on the pronotum. A striking variation in the later stages has a dark mid-dorsal stripe and sides of pronotum pale.) In the fourth and fifth stages this species can always be recognized by the narrow impressed line (foveola) indenting the front margin of the head (vertex) on each side just in front of the top of the eyes (lens needed to see it.) (Fig. 9) (This line can usually be made out in the third stage also but not well.) Legs pale, unspotted, the hind thighs, on the outer side, with a longitudinal brownish stripe with faint edges.

Meadow Slant-faced Grasshopper, *Chorthippus curtipennis*.¹²

- EE. First and second stages usually pale grass green; the front and middle legs thickly spotted with dusky: hind thighs with the basal three-fourths light red and with rows of dark spots on the ridges. Third stage green or brown, the markings on legs much the same as in the earlier stages. Fourth and fifth stages varying greatly in color and pattern of marking (green or brown, with more or less black) but the absence of linear impressions on the vertex of the head at once distinguishes this species from the preceding. It is not known from northern Maine.

Pasture Grasshopper, *Orphulella speciosa*.¹²

- DD. Face in side view rounding smoothly into the top of the head without marked angle at the vertex (Fig. 10).
- F. Top of collar (disk of pronotum) *sloping downward roof-wise* (Fig. 12), from a median ridge to the low lateral ridges, which diverge strongly backward. Distance between eyes on top of head equaling width of an eye (Fig. 14). A robust brown or gray species, mottled with darker, and usually showing a blackish bar across the face on a level with and covering the lower half of the eyes. No prominent projection on the throat between the bases of the front legs in any stage.

Clear-winged Grasshopper, *Camnula pellucida*.

- FF. Top of collar (disk of pronotum) *curving* smoothly downward from the low median ridge into the sides (Fig. 13); lateral ridges present only in the adult. Distance between the eyes on top of head much less than width of an eye (Fig. 15). In the fifth, fourth, and often in the third stages a prominent spine is noticeable projecting downward between the bases of the front legs (prosternal spine). This cannot usually be made out satisfactorily in the first, second, and often in the third stages.

Spine-throated Grasshopper.

¹²The only other slant-faced grasshopper liable to be confused with either of these species in the young stages is the Sprinkled Grasshopper, *Chloealtis conspersa*, which may always be separated by having the sides of the pronotum longer than deep.

- G. Outer face of hind thighs marked obliquely with dusky and pale bands (Fig. 16).

Lesser Migratory Grasshopper, *Melanoplus atlanis*.

- GG. Outer face of the hind thighs (stages 2, 3, 4, 5) with a longitudinal dark stripe on its dorsal half (Fig. 17). The lower half of the outer face and the groove below it also usually more or less dusky in stage 1.

- H. Prevailing color grass green (stages 2, 3, 4, 5) with a pair of purplish (or dusky brown) stripes on the back running backward from the head, bordered below on the collar by narrow pale stripes, on the abdomen separated only by the pale median line. Streak on the hind thighs also often purplish. Brown individuals are not uncommon, sometimes heavily marked with dusky. Prosternal spine sharp-pointed. In the fourth and fifth stages the male may be readily distinguished by the lack of a furcula (see Fig. 21). Stage 1 is more or less dusky, sprinkled with black spots, and closely resembles the following species.

Two-striped Grasshopper, *Melanoplus bivittatus*.

- HH. Sides of head and collar with a conspicuous white stripe which starts as a spot below the eye and curves upward and backward across the side of the collar (Fig. 10). It is widest in front and is bordered above by a black stripe running backward from the middle of the eyes, and below by dusky areas on the face and collar. In any stage this species may nearly always be separated from *bivittatus* by the presence of *white below the eyes* but cut off from them by a narrow black line, and by having an equally broad black stripe above the white one on the face. Prosternal spine rounded at tip. The fourth and fifth stages of the male show a distinct furcula, rudiments of it often show in the third stage (see Fig. 22). In general effect this is usually a strongly striped species.

Red-legged Grasshopper, *Melanoplus femur-rubrum*.

The last four species named have a country-wide distribution from the Atlantic to the Pacific and are among the most destructive of those of the entire continent, having repeatedly done severe damage. They are found throughout the State of Maine and often all together in the same field. The Lesser and the Clear-wing are partial to dry soils of sandy texture, the Red-legged and the Two striped prefer damp situations and rank vegetation.

ADULT STAGE.

The Two-striped or Yellow-striped Grasshopper is the stout, greenish or brownish yellow hopper, an inch to an inch and a half in length, with a yellowish stripe along each side of its back, common in mid-summer in the rank verdure of meadows and springy runs. The Lesser and the Red-legged are of medium size, about an inch long, less robust than the Two-striped, and usually reddish brown above. In the Lesser the hind thighs are obliquely banded with dusky; not so in the Red-legged (both, however, usually have red hind tibiae in Maine).

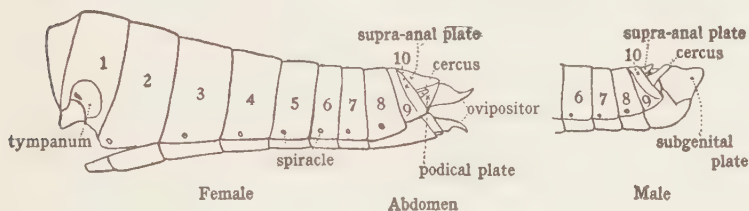


FIG. 18. Outline from left side of abdomen of female Carolina Grasshopper (*Dissosteira carolina*) showing segments numbered, position of hearing organ (tympanum), breathing-pores (spiracles), ovipositor, etc. Enlarged. (After Morse)

FIG. 19. Outline from left side of end of abdomen of male Carolina Grasshopper, showing parts. Enlarged. (After Morse)

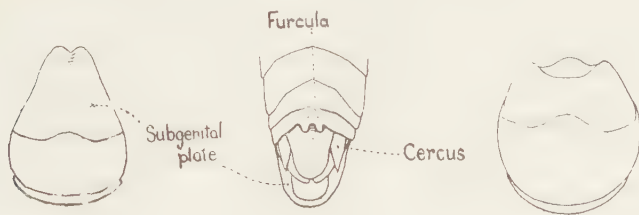


FIG. 20. Outline from rear of end of abdomen of adult male Lesser Grasshopper (*Melanoplus atlantis*) showing notched subgenital plate. Much enlarged. (Original)

FIG. 21. Outline from above of end of abdomen of young (4th stage) Red-legged Grasshopper showing furcula and cerci. Much enlarged. (Original)

FIG. 22. Outline from rear of end of abdomen of adult male Red-legged Grasshopper (*Melanoplus femur-rubrum*). Much enlarged. (Original)

The male of the Lesser has the end of the abdomen (sub-genital plate) a little prolonged and slightly notched at the tip (Fig. 20), in that of the Red-legged it is full and round, unnotched (Fig. 22). The cercus (Figs. 18, 19, 21, 23, 24, 25) and pro-sternal spine also are characteristic in form in the three species.

The Clear-winged Grasshopper is also of medium size, stouter than the Lesser and Red-legged, a dead grass color spotted with black or dark brown, and lacks the prominent spine or "Adam's apple" on the under side of the throat possessed by the other three species. The wings of all four are transparent.



FIG. 23. Outline of left cercus of adult male Lesser Grasshopper. Much enlarged. (Original)

FIG. 24. Same of Two-striped Grasshopper (*Melanoplus bivittatus*) drawn to same scale. Much enlarged. (Original)

FIG. 25. Same of Red-legged Grasshopper, drawn to scale. Much enlarged. (Original)

INJURIOUS INDOOR ORTHOPTERA.

CRICKETS, COCKROACHES, EARWIGS

Besides those which ravage our fields and gardens several members of this group of insects are pests in dwellings, shops, or stores. These are chiefly introduced species of foreign origin which find life easiest as hangers-on of man, who unwillingly provides them with food and shelter and without whose presence they would probably be unable to survive in this climate. Two others, recent arrivals in New England, though not yet reported from this State, are liable to gain entrance at any time.

Of these household or so-called "domiciliary" pests, the cockroaches are most numerous. The croton-bug or water-bug (*Blattella germanica*), the oriental roach or "black beetle" (*Blattella orientalis*), and the large American roach (*Periplaneta americana*) are often found in sugar-refineries, slaughter-houses, and untidy bakeries and restaurants, sometimes literally swarming in dark, moist holes near steam and hot water pipes during the

day and coming forth at night to feed. Though they act partly as scavengers, they destroy large quantities of food-stuffs prized by man and procured for his own benefit and their presence is unsanitary and obnoxious. One native species, the Pennsylvania roach (*Parcoblatta pennsylvanica*), sometimes becomes a nuisance in cottages and camps at the shore or in the woods, maintaining itself under natural conditions and sometimes multiplying greatly in the shelter afforded by man's construction. No cases of specific injury have been reported from New England, though it is locally common, but damage has been done in the Central States.

Remedies for cockroaches are numerous, but the essential features are the maintenance of strictly cleanly sanitary conditions in infested buildings, combined with constant vigilance and effective treatment with some of the various poisons or repellants when needed.

Exotic roaches of various species are frequently brought into this country with tropical fruit, hiding in the recesses of banana-bunches or among the wrappings of fruit or plants, and make their appearance in unexpected places. Several very large, dark-colored kinds have been recorded from the State, two medium-sized brown ones are occasionally seen, and now and then a beautiful green species is captured. These tropical roaches, though undoubtedly introduced many times, have never succeeded in establishing themselves on a permanent basis, though two kinds (*Periplaneta australasiae* and *Pycnoscelus surinamensis*) have lived for several months in conservatories in southern New England. Another greenhouse orthopteron is the Asiatic camel-cricket or cave-cricket, a curious, dark brown, hump-backed, hopper with extremely long legs and antennae which sometimes appears in greenhouses, having been introduced into many parts of Europe and America in the wrappings of plants, and which maintains itself for long periods under conservatory conditions but seems to do little or no injury.

Very recently (1919, 1920) the European House-cricket (the "cricket on the hearth"), has gained a temporary footing in Connecticut and eastern Massachusetts in dwelling houses and has done considerable injury to food-stuffs, stored articles, and damp clothing in the laundry, besides annoying people with its persistent chirping. It is a straw-colored species, with brown or blackish markings, a little smaller than our common field-cricket.

These conservatory and household pests can usually be conquered or at least controlled (every effort should be made to exterminate them where practicable) by the use of poisoned bread-and-milk or other attractive foods.

One other obnoxious insect of this order needs to be reckoned with:—the European earwig (*Forficula auricularia*) which has unfortunately become fully established at Newport, R. I., and the vicinity and bids fair to spread over the whole country. This is a light brown insect about half an inch long, bearing at the end of the body a pair of horny pincers a sixth to a third of an inch in length. It is nocturnal, and hides by day in any convenient shelter. It is obnoxious by flying in swarms to lights at night, entering cracks and crannies of houses, feeding on flowers and the soft parts of plants. (Fig. 6)

Prompt notice should be sent to the Experiment Station of the capture of these introduced pests, accompanied by specimens and a full statement of the circumstances and locality. Additional information concerning the European earwig, discussion of remedies, etc., may be found in Bulletin 566, U. S. Dept. Agriculture.

The following Key will enable anyone to classify adult insects of this order as far as the family. Anyone desirous of pursuing the subject further should consult the author's "Manual of the Orthoptera of New England" published by the Boston Society of Natural History.

KEY TO FAMILIES OF ORTHOPTERA OF MAINE. ADULTS.

- A. Abdomen ending in a pair of conspicuous, horny, unjointed pincers or forceps-like appendages (Fig. 6). Feet (tarsi) three-jointed. Legs similar in form and nearly equal in length. Wings, if present, folded transversely as well as radially. Earwigs, *Forficulidae*.
- AA. Abdomen without forceps at end or if so with five-jointed tarsi. Wings, if present, folded in fan-like plaits to the base.
- B. Legs equal or nearly equal in size, the hind thighs not enlarged. Auditory and sound-producing organs not present. Wing-covers and wings in normal position throughout the young stages. Ovipositor not conspicuous.
- C. Body broad, depressed. Head nearly or quite concealed beneath the pronotum, the face ventral, mouth posterior.

Cockroaches, *Blattidae*.

CC. Body cylindrical, elongate. Head freely visible from above.

Walkingsticks, *Phasmidae*.

BB. Hind legs longest, the thighs enlarged for leaping. Rudiments of wing-covers and wings, when present, reversed in position in later stages of young.....Jumping, or Saltatorial, Orthoptera.

D. Antennae usually much longer than the body, tapering to a delicate tip. Auditory organs on base of front tibiae. Sounds produced by rubbing wing-covers together while at rest.

E. Tarsi four-jointed. Wing-covers sloping at sides of body. Ovipositor compressed, blade-like.

Katyids, Long-horned Grasshoppers, Cave-crickets, *Tettigoniidae*.

EE. Tarsi three-jointed. Wing-covers flat above, bent abruptly down at sides of body. Ovipositor needle-like, cylindrical.

Crickets, *Gryllidae*.

DD. Antennae shorter than the body, usually thread-like, sometimes enlarged at base. Tarsi three-jointed. Auditory organs at sides of base of abdomen. Scraping sounds produced by many species while at rest by rubbing hind thighs against the wing-covers, and rattling sounds in flight. Ovipositor composed of four short, sharp-tipped, horny pieces arranged in dorsal and ventral pairs.

Short-horned Grasshoppers, *Acrididae*.

A LIST OF THE ORTHOPTERA OF THE STATE OF MAINE.

The following list contains all species of Orthoptera recorded or positively known from the State of Maine. Several others probably inhabit the State but have not as yet been taken or recorded. One species (*Hippiscus rugosus* Scudd.), reported a half century ago, has not been seen since and has perhaps become extinct within the State.

According to their intra-State distribution they fall into three chief groups: 1st,—species found in the entire State; 2nd,—species found only in the colder, more boreal districts; 3rd,—species found only in the warmer southern portion, of which four are restricted to the immediate sea-shore.

Sixteen *Acrididae*, four *Gryllidae*, and eight *Tettigoniidae* are believed to occur in the entire State; three *Acrididae*, and two *Tettigoniidae* are recognized as boreal; and eleven *Acrididae*, four *Gryllidae*, three *Tettigoniidae*, one walkingstick, two cockroaches, and one earwig are southern. About twenty other species are of accidental occurrence or too little is known of their distribution in the State to place them with certainty.

Seventy-four species are here recorded. Prof. S. I. Smith, in his article "On the Orthoptera of Maine" published February, 1868, in the Proceedings of the Portland Society of Natural History, treated thirty-nine, five of which are now recognized as synonyms. Probably less than a dozen native species remain to be discovered in the State, most of which, if found, will prove to be scarce and local in the southwestern counties.

FORFICULIDAE.—Earwigs.

1. Maritime Earwig, *Anisolabis maritima* (Géné).
Sea-shore. Lives as a scavenger among sea-weed and stones at or near high-water mark. Reported erroneously but probably occurs on the shore of Casco Bay.
2. Little Earwig, *Labis minor* (Linné).
Rare. Nocturnal; flies at dusk and to lights. Probably a scavenger. Norway, Sept. 14, 15 (Smith).

BLATTIDAE.—Cockroaches.

3. Northern Wood-Roach, *Parcoblatta virginica* (Brunner).
Under bark, stones, etc.* Adults in June and July, in their usual haunts, and flying to lights. Norway,—Smith. M. C. Z. (Hebard). Orono, July 27, 1906, Exp. Sta. (Hebard).
4. Bicolored Wood-Roach. Pennsylvanian Wood-Roach, *Parcoblatta pennsylvanica* (DeGeer)
Locally common under boards and rubbish at sea-shore and lake-side camps. In Indiana has sometimes become a nuisance in camps and cottages. Prout's Neck,—M. C. Z. (Hebard); Bluff Pond, July 28, 1908, 1 female, 1 yg.(?) (Portl. Soc. Nat. Hist.).
5. German Roach, *Blattella germanica* (Linné).
Lives in cities or wherever introduced with merchandise, frequenting the vicinity of water-pipes in houses, restaurants, etc. (hence "Croton-bug" in New York). Adults and young at all seasons. Norway (Smith); Isle of Springs, Aug. 30, 1909 (Exp. Sta.).
6. Australian Roach, *Periplaneta australasiae* (Fab.).
Tropical; introduced accidentally; occasionally becomes established in greenhouses in southern New England. Orono, Aug. 15, 1912 (Exp. Sta.).
7. Oriental Roach, *Blatta orientalis* Linné.
Often common in untidy restaurants and warm cellars in cities. At all seasons. Norway (Smith); Portland, Aug. 17, 1918. (Port. S. N. H.); Orono (?) May 19, 1906 (Exp. Sta.).

8. Silky Roach, *Nyctibora laevigata* (Beauv.).
Tropical; adventive; probably brought in with bananas. Orono, May 16, 1889 (Exp. Sta.).
9. *Eurycotis opaca* (Brunner).
See remarks above. Orono, June 18, 1909 (Exp. Sta.).
10. *Eurycotis tibialis* Hebard.
See remarks above. Orono(?) (Exp. Sta.).
11. Green Roach, *Panchlora cubensis* Sauss.
Tropical; adventive; frequently brought in with bananas. Orono, 1892, in tropical fruit (Hebard); Augusta, 1906, U. S. N. M. (Hebard); Portland, 1918, J. Erlick (Portl. S. N. H.).

PHASMIDAE,—Walkingsticks.

12. Northern Walkingstick, *Diapheromera femorata* (Say).
Rare. Lives among deciduous shrubbery and trees and has been known to defoliate large areas of woodland in New York and Iowa. Matures late in the season, Sept. S. Bridgton, 1907 (Exp. Sta.). 1 male.

TETTIGONIIDAE,—Long-horned Grasshoppers, Katydids, etc.

13. Northern Bush-Katydid, *Scudderella septentrionalis* (Serville).
Very rare. Undergrowth in woods. Maine, t. Brunner (Scudder); Norway,—Smith. M. C. Z. (Scudder).
14. Texan Bush-Katydid, *Scudderella texensis* Sauss. et Pict.
Shrubbery in swampy grounds, in August and September, probably. Norway,—Smith. M. C. Z. (Scudder).
15. Broad-winged Bush-Katydid, *Scudderella pistillata* Brunner.
Entire State. Common in low shrubbery in August and September. This has been taken at Fort Fairfield, Moosehead Lake (Scudder), Whitneyville, Brunswick, Kezar Falls, Eliot, and many intermediate localities, from Aug. 4 to Sept. 17.
16. Curve-tailed Bush-Katydid, Narrow-winged Bush-Katydid, *Scudderella curvicauda curvicauda* (DeGeer).
Locally common in western Maine from late July till mid-September. Orono, Solon, Fryeburg, Brunswick, Eliot, and many intermediate localities from July 27 to Sept. 18.
17. Northern Curve-tailed Bush-Katydid, *Scudderella curvicauda borealis* R. et H.
A small, northern race of the preceding, found in shrubbery in cold bogs. Known from Whitneyville, Cherryfield, Orono, Songo Lock, Aug. 5 to 30.
18. Fork-tailed Bush-Katydid, *Scudderella furcata* Brunner.
Common in and near shrubbery in southwestern Maine in Aug-

ust and September. Taken at Popham Beach, Brunswick, Deering, Cape Elizabeth, Norway, Kezar Falls, Lebanon, Eliot, Aug. 21 to Sept. 18.

19. The Swordbearer, or Conehead, *Neoconocephalus ensiger* (Harris).
Common in southwestern Maine. It lives among and lays its eggs in coarse grasses, wild and cultivated. Known from Orono, Winthrop, Monmouth, Brunswick, Topsham, Norway, Limington, Lyman, Sanford, Wells, Aug. 23 to Sept. 9. Smith reported it "quite common late July to September," at Norway.
20. Larger, or Common Meadow-grasshopper, *Orchelimum vulgare* Harris.
Common in southwestern Maine in grass and herbage from Aug. 1 onward. Canaan, Norridgewock, Norway, Naples, Deering.
21. Bruner's Meadow-grasshopper, *Orchelimum gladiator* Bruner.
With the same habits and seasons as the preceding species and about equally common. Known from Orono, Veazie, Frankfort, Hermon, and Fryeburg, Aug. 3 to 27.
22. Dusky-faced Meadow-grasshopper, *Orchelimum concinnum* Scudder.
Common locally in the coastwise saltmarshes, at least from Portland south, usually among *Spartina* and other coarse grasses. Known from Scarboro, Sept. 5, York and Brave Boat Harbor, Aug. 23.
23. Slender Meadow-grasshopper, *Conocephalus fasciatus* (DeGeer).
Entire State. July 15 to October. Generally distributed in grasslands and marshes; common, sometimes literally swarming locally. Fort Kent, Princeton, Roque Bluff, Orono, Jackman, Scarboro, Norway, and ten intermediate localities, July 13 to Sept. 8.
24. Short-winged Meadow-grasshopper, *Conocephalus brevipennis* (Scudder).
Common in at least the southern and central parts of Maine. Habits and seasons similar to those of the preceding species. Eastport, abundant,—(Smith); Orono, Norridgewock, Weld, Norway, Fryeburg, Porter, Limington, Lyman, Brunswick, Scarboro.
25. Saltmarsh Meadow-grasshopper, *Conocephalus spartinae* (Fox).
Locally common in the short grass of saltmarshes from Portland southward. August and September. Scarboro, Pine Point, Wells Beach, York Beach, Brave Boat Harbor, Aug. 23 to Sept. 9.
26. Asiatic or Conservatory Cave-cricket, *Diestrammena marmorata* (DeHaan).
An exotic species, introduced into greenhouses among the wrappings of plants, and maintaining itself under the artificial conditions found there, but seldom doing injury. One instance,—Kennebunk.

27. Yellow Cave-cricket, *Ceuthophilus neglectus* Scudder.
In damp places under boards, bark, logs, etc., and in cellars.
Scarce. Jackman, Veazie,—August.
28. Spotted Cave-cricket, *Ceuthophilus maculatus* (Harris).
Common; probably found throughout southern Maine, and perhaps throughout the State. Calais, Treat's Id. near Eastport—(Smith), Bar Harbor, Veazie, Katahdin View Camp on West Branch of Penobscot R., Norway, Cape Elizabeth. All captures seen were taken in August, but in cellars, may be found throughout the year.
29. Woodland Cave-cricket, *Ceuthophilus terrestris* Scudder.
A northern species, sometimes locally common in cold woodlands and forests, at least in other States. Orono, August—September (Patch).
30. Common Field-cricket, *Gryllus assimilis* (Fabr.).
Abundant throughout the State. July till frost. Occasional specimens could probably be found much earlier. Fort Kent, Calais (Smith), Bingham, Norway, Brunswick, Sanford, and thirteen intermediate localities.
31. Striped Grass-cricket, *Nemobius fasciatus* (DeGeer).
Throughout the State. July till frost. One of the most abundant and ubiquitous species of Orthoptera found in Maine mowing-lands and gardens; often in destructive numbers. Fort Kent, Cutler, Mt. Desert, Bingham, Fryeburg, Lebanon, and over twenty intermediate localities.
32. Sand Cricket, *Nemobius griseus* E. M. Walker.
Very local, in sandy districts, usually rare but sometimes quite common. Popham Beach, Brunswick, Songo Lock, Limington, Scarborough, from Aug. 22 to Sept. 6.
33. Sphagnum Cricket, *Nemobius palustris* Blatchley.
Locally common in sphagnum bogs. August and September. Orono, Aug. 5 to 30. Young were common on the earlier date.
34. Carolina Ground-cricket, *Nemobius carolinus* Scudder.
Edges of woodlands, especially near streams, cool grasslands, etc. Locally common throughout the State. All captures were made in August but it doubtless lives until freezing weather sets in. Fort Fairfield, Caribou, Grand Lake Stream, Bar Harbor (C. W. Johnson), Jackman, Embden, New Sharon, Waterville, Aug. 15 to 24.
35. Snowy Tree-cricket, *Oecanthus niveus* (DeGeer).
Common in southern New England in August and September in shrubbery near houses. Its rhythmical song is characteristic and should lead to its easy detection wherever found. Near Portland, Sept. 1909 (Exp. Sta.).
36. Dusky Tree-cricket, *Oecanthus nigricornis* Walker.
Locally common in weedy thickets, low shrubbery, etc., in south-

western Maine in August and September. Brunswick, Norridgewock, Norway (Geo. Howe), Limington, Sanford, Eliot, Sept. 1 to 17.

37. Four-spotted Tree-cricket, *Oecanthus quadripunctatus* Beutenmüller. With the same habits, seasons, and distribution as the preceding but more plentiful and generally distributed. Brunswick, Monmouth, Norridgewock, Porter, Naples, Eliot.

ACRIDIDAE.—True Locusts,¹³ Short-horned Grasshoppers.

38. Bunchgrass Locust, *Pseudopomala brachyptera* (Scudder).
Locally common in coarse grasses, especially *Andropogon*, on dry, sterile soil. Taken at Solon, Winthrop, Monmouth, Brunswick, Woodstock, Fryeburg, Aug. 18 to Sept. 4.
39. Pasture Locust, *Orphulella speciosa* (Scudder).
Locally common, often abundant, throughout southern Maine, especially on the sandy soils of the southwestern part of the State. July till October. Grand Lake Stream, Whitneyville, Mt. Desert, Aurora, Orono, Norridgewock, Norway; summit of Speckled Mt., Stoneham; Porter, Eliot, and nine intermediate localities, from July 28 till Sept. 17.
40. Sprinkled Locust, *Chlocaltis conspersa* Harris.
Common in wild land, pastures, etc., with an abundance of woody debris, stumps, etc., in which the eggs are deposited. Probably throughout the State. Matures early, in June, and is found until October. Grand Lake Stream, Roque Bluff, Orono, Norridgewock, Weld, Fryeburg, Brunswick, Deering, and seven intermediate localities, from July 12 to Sept. 8. Young in the third, fourth, and fifth stages were found at Orono between June 14 and 25.
41. Meadow Slant-faced Locust, Short-winged Meadow Locust, *Chorthippus curtipennis* (Harris).
Entire State, nearly ubiquitous, and probably can be found from late June until November. One of the most generally distributed grasshoppers in the State, common almost everywhere in grass-

¹³It has been a custom of entomologists to call the *Acrididae* (short-horned grasshoppers) "locusts," as in Scripture, reserving the term "grasshopper" for another group of Orthoptera with long antennae. In this list these names are given in accordance with such usage, although in the main part of the bulletin "grasshopper" has been applied in its broader, colloquial American sense so as to include the short-horned grasshoppers. This, a popular custom, is sanctioned by the American Association of Economic Entomologists who, at their thirty-second annual meeting, voted "that the term *grasshopper* be substituted for *locust*."

land, especially if moist, and often extremely plentiful. Young as well as adults are found throughout the season. I have seen all five stages of the young taken at West Pownal on June 7, and the second stage at Brunswick on Sept. 3. It is common to find three or four stages in the net at once. Fort Kent, Lubec, Mt. Desert, Jackman; summit of Speckled Mt., Stoneham; Eliot, and many intermediate places, from July 27 to Oct. 1.

42. Striped Sedge Locust, *Mecostethus lineatus* (Scudder).

Common locally throughout the State in cold, wet, sedgy meadows and bogs, along streams, about ponds, etc. Adults are probably to be found from late July until freezing weather sets in. Fort Kent, plateau (4700 ft.) of Mt. Katahdin, Cutler, Whitneyville, Roque Bluff, Cherryfield, Orono, York, Aug. 8 to 28. Also young in fifth stage on Aug. 9 and 13.

43. Northern Sedge Locust, *Mecostethus gracilis* (Scudder).

In the same type of meadows as the preceding, but less generally distributed and less plentiful when found. Cutler, Whitneyville, Mt. Desert, Gt. Cranberry Id. (Hebard), Veazie, Orono, Jackman, Norway (Smith), Aug. 5 to 27.

44. Autumn Yellow-winged Locust, *Arphia xanthoptera* (Burm.).

Locally common in southern New England in dry fields and pastures on sandy loam in August and September. Here recorded from the state for the first time. Wells, Sept. 9, 1920 (A. P. M.).

45. Spring Yellow-winged Locust, *Arphia sulphurea* (Fab.).

A smaller, spring-time species, mature from May till July. common in southwestern Maine. Young in the first three stages are to be found early in September and hibernate probably in the third and fourth stages. It is more generally distributed, often occurring in bushy pastures, and extends further north than *xanthoptera*. I have seen adults from Norway (Geo. Howe) and Deering, and young from Popham Beach, Limington, Wells, and Lebanon.

46. Green-striped Locust, *Chortophaga viridifasciata* (DeGeer).

Widely and generally distributed, common in grasslands early in the season. Hibernates as young chiefly in the third stage. It probably has a much wider distribution than is here indicated. Orono, June 6 to 14; Norway, last of May to July 1 (Smith). Young in second, third and fourth stages at Brunswick, Standish, Limington, Hollis, Wells Beach, Sanford, and Lebanon.

47. Dusky Locust *Encoptolophus sordidus* (Burm.).

A very common species late in the season, abundant locally in southwestern Maine in old mowing-fields and pastures on light soil. Orono, Norway, Fryeburg, Porter, Deering, Wells, Eliot, and other places, Aug. 21 to Sept. 18. Young in fifth stage from Aug. 22 to Sept. 18.

48. Clear-winged Locust, *Camnula pellucida* (Scudder).
Entire State, maturing in June or early July and active till frost. Generally distributed, common, often abundant in dry pastures and fields, one of the species which multiply to destructive numbers from time to time and become serious pests. Fort Kent, Orono, Whiting, Norway, Eliot, and many intermediate localities, July 21 to Sept. 17. The young hatch in late May and early June; the second and third stages were taken at Orono on June 9, 1920.
49. Coral-winged Locust, *Pardalophora apiculata* (Harris).
Entire State probably. Common locally but not plentiful, on dry soil of bushy pastures and hillsides from late April till August. Hibernates in third stage of young. Sherman (Exp. Sta.), plateau of Mt. Katahdin (4700 ft.), Orono, Norridgewock, Norway (Smith). Young in second and third stages were taken at Kezar Falls, Limington, Wells, Lebanon, and Eliot, Sept. 6 to 18.
50. Wrinkled Locust, *Hippiscus rugosus* (Scudder).
Recorded from "Maine (Packard)" by Scudder (Mat. Monog. 1862) and said by Smith (Orth. Me., 1868) to be not common at Norway. This species has not been reported from New England since. In Virginia it is very common on sandy ground in mid-summer. If still living in New England it probably occurs locally on the coastal plain of southwestern Maine or southeastern Massachusetts.
51. Carolina Locust, Black-winged or "Flying Grasshopper," "Quaker," *Dissosteira carolina* (Linné).
A very common and widely distributed species, seen on every dusty road in mid-summer. Houlton, Roque Bluff, base of Mt. Katahdin, Norridgewock, Norway, Eliot, and fifteen intermediate localities, from July 21 to Sept. 18. Young in fourth and fifth stages were found at Limington as late as Sept. 6.
52. Scudder's Collared Locust, *Spharagemon collaris* (Scudder), race *scudderi* Morse.
Very common locally in southwestern Maine in old fields and pastures on light soil. Taken at Brunswick, Standish, Limington, Wells, Lebanon, from Sept. 2 to 18.
53. Boll's Locust, *Spharagemon bolli* Scudder.
Widely distributed in southwestern Maine, usually scarce but sometimes locally common in bushy pastures on light soil. Taken at Brunswick, Norway, Porter, Limington, Aug. 16 to Sept. 8.
54. Sand Locust, Long-horned Locust, *Psinidia fenestralis* (Serville).
A very common and locally plentiful species on sand in southwestern Maine. Brunswick, Norridgewock, Norway, Fryeburg, Oxford, Standish, Limington, Wells, Aug. 16 to Sept. 9.

55. Seaside Locust, *Trimerotropis maritima* (Harris).
Common on the sandy beaches of the coast of southwestern Maine. Its distribution probably does not extend much further east than recorded here. Adults may probably be found from early August till November. Taken at Wells Beach, Pine Point, Scarborough Beach, Popham Beach, Sept. 4 to 26.
56. Snapping Locust, Broad-winged Locust, *Circotettix verruculatus* (Kirby).
Common over the entire State. Especially fond of weathered rock exposures, but where plentiful is found on roads and dry bare spots of all sorts. Mars Hill, Cutler, Mt. Desert, plateau of Mt. Katahdin (4700 ft.), Norway, Popham Beach, Monhegan Id., Eliot, etc., July 12 to Sept. 17.
57. White Mountain Wingless Locust, *Podisma glacialis* (Scudder).
A characteristic and locally common inhabitant of timber-line thickets on cold, moist mountain-tops and shrubby growths in cold bogs and swamps down to sea-level in eastern Maine. Mt. Katahdin (F. P. Briggs), Speckled Mt., Grafton (Portland Soc. N. H.); Speckled Mt., Stoneham (Smith, Morse); Jackman (Harvey). I have taken it also at Cutler, Machias, Whitneyville, Roque Bluff, Cherryfield, Orono, Houlton and Umbagog Lake. Adults in August and September.
58. Lesser, or Lesser Migratory Locust, *Melanoplus mexicanus atlanis* (Riley).
Throughout the State. Adults from July till frost. Young hatch in June, possibly in late May on dry sunny exposures. Generally distributed, locally abundant, awaiting only a favorable opportunity to multiply into destructive hordes. The young should be looked for early in June and precautions taken if necessary. Fort Kent, Roque Bluff, Mt. Katahdin, Jackman, Wells Beach, and many intermediate localities from July 16 onward.
59. Banded Locust, *Melanoplus fasciatus* (Walker).
Entire State. Common and widely distributed in blueberry and other low thickets on dry soil from sea-level to the summit of Mt. Katahdin. Mars Hill, Grand Lake Stream, Roque Bluff, Norridgewock; Speckled Mt., Stoneham; Lebanon, and many others, July 13 to Sept. 18. Fifth stage young were found at Cherryfield on Aug. 7; third, fourth and fifth in eastern Massachusetts on June 23.
60. Red-legged Locust, *Melanoplus femur-rubrum* (DeGeer).
Entire State; generally distributed, common, often abundant. Adults from late July or early August till end of season. Young from early in July till October. All stages, but chiefly the later, were taken at Orono, Aug. 16, 1920; the second, fourth and fifth at Popham Beach, Sept. 4; the fourth at Lebanon, Sept. 18. This is the common "grasshopper" to which most of the injury done

to crops is attributed, and which is often rightly blamed therefor, but the Lesser and the Two-striped are about equally to blame.

61. Northern Locust, *Melanoplus borealis* (Fieber).

A boreal species, found in grasslands early in the season, lingering till August. It has been taken at Orono as early as June 6, at Mars Hill Aug. 25. I have captured it on intermediate dates at Houlton, Wesley Corner, Trescott, Cutler, Cherryfield, Mt. Desert, Norway, and have found its remains at Fort Kent, Aug. 29.

62. Little Locust, *Melanoplus confusus* Scudder.

This is also an early maturing species which appears as an adult early in June in Massachusetts but probably is somewhat later in Maine. By midsummer it dies off and is seldom seen. I have taken it at Fryeburg in August, and at Limington, Sept. 6. It is most common in old fields on light soil.

63. Broad-necked Locust, *Melanoplus luridus* (Dodge).

Probably throughout the State, though I have not seen specimens from southeast of Orono. It is common but never abundant in bushy pastures, open woodlands, etc., reaching maturity in August and active till freezing weather sets in. Mars Hill, Solon, Weld, Bingham; Speckled Mt., Stoneham; Porter, Brunswick, Eliot, and many other localities in southwestern Maine, from Aug. 15 to Sept. 17. Fourth and fifth stages are common as late as Sept. 9.

64. Pine-tree Locust, *Melanoplus punctulatus* (Scudder).

Scarce to rare, but sometimes locally common. Lives on white pines, larches, etc., and deposits its eggs in worm-holes in logs, cracks in the trunks, etc. A late-appearing species, seldom seen until late August or September. Westbrook, Sept. 15 (Portl. Soc. N. H.); Brunswick, Sept. 2; Lebanon, Sept. 18.

65. Two-striped Locust, *Melanoplus bivittatus* (Say).

This is the "big yellow grasshopper" common everywhere throughout the State, especially in moist jungles of rank weeds and grass, and which does much damage locally every now and then to garden crops of peas, beans, corn, etc. One of the four most dangerous species in the State. It matures early. The young as usually seen are pale green little 'hoppers with purplish stripes down the back. Fort Kent, Trescott, Jackman, Lebanon, and many other localities, including Monhegan Id., from July 16 to Oct. 1. Young in all stages may be found June 25; the fourth and fifth stages as late as the first week in September.

66. Dawson's Locust, *Melanoplus dawsoni* (Scudder).

A short-winged species, known in New England from but four localities in Maine and New Hampshire and rare in those. I have taken it only among coarse grasses and weeds on light soil (especially *Andropogon scoparius*) at Brunswick and Sanford from

August 4 to Sept. 9, and it has been reported to me from Limington by J. A. G. Rehn.

67. Smith's Locust, *Melanoplus manicus* (Smith).

This is another short-winged species, discovered by Prof. Smith on the summit of Speckled Mt., Stoneham, where it is common in the blueberry thickets. It has been found also in two localities at Cherryfield, and at Mt. Desert. Dates of capture range from Aug. 7 to 18, which could probably be much extended by search.

68. Crested Pygmy Locust, *Nomotettix cristatus* (Scudder).

Common throughout the State, especially on light soils of abandoned fields and pastures. Hibernates in adult stage but may be found in every month of the season. The young hatch in spring or early summer, reach maturity in fall and spend winter as adults. Fort Kent, Roque Bluff, Mt. Desert, Bingham, Fryeburg, Lebanon, and many intermediate localities, Aug. 4 to Sept. 18. Long-winged examples are occasionally captured,—I have taken them at Whitneyville, Cherryfield, Scarboro, and Cornish.

69. Angulate Pygmy Locust, *Acrydium granulatum granulatum* Kirby.

Entire State. Common on bare ground of damp places, moist meadows, etc. Same seasonal distribution as preceding species. Fort Kent, Trescott, Mt. Desert, Fryeburg, Limington, and many other places, May 5 to Sept. 6. Smith reports it very common at Norway last of April to early June and again last of August through September.

70. Western Angulate Pygmy Locust, *Acrydium granulatum incurvatum* (Hancock).

A broad-shouldered western form of the preceding species which has been taken at Moosehead Lake by C. W. Johnson and C. A. Frost in July.

71. Ornate Pygmy Locust, *Acrydium ornatum* Say.

Smith reports this species common at Norway from April to September. I have seen it from Orono, Bingham, Fryeburg, and Monmouth, June 8 to September 25. It prefers a habitat neither wet nor dry, intermediate in character between that of the Crested and the Angulate species.

72. Hancock's Pygmy Locust, *Acrydium hancocki* Morse.

Scarce; damp bare spots in fields and along roadsides. This is probably a variety of the preceding, described from Iowa, and since taken in northern Maine and New Hampshire.

73. Obscure Pygmy Locust, *Acrydium arenosum angustum* (Hancock).

With the same seasons and habits as the Ornate Pygmy Locust. Orono, Cherryfield, Bingham, Paris (C. A. Frost), Fryeburg, June 18, Aug. 9 to 30.

74. Sedge Pygmy Locust, *Tettigidea lateralis parvipennis* (Harris).

Probably throughout the State. Adults in every month of the

season, April to October, and hibernating. Young most plentiful in midsummer. Norway (Smith), common, April and May, late August and September. Known also from Fort Kent, Princeton, Cherryfield, Orono, Veazie, Embden, Norridgewock, Fryeburg, Songo Lock, Eliot, from June 25 to Sept. 17.

AUTHOR'S REPORT.

I present herewith my report of work done on the Orthoptera of Maine during the past season.

This group of insects, though less injurious in Maine than some other States, is an important one economically, through its attacks on field and garden crops and in other ways.

The purpose of the inquiry was to secure all the information practicable in the time at command regarding its exact status in Maine, including the number of species present, their distribution, life histories, injuries, etc., preparatory to a bulletin on the subject which would supply such information in accessible form when needed; and to build up the Experiment Station collection of these insects to serve as a reference collection for the identification of material sent in.

Having spent a month in the State in 1913 in a somewhat similar investigation under private auspices, and having made several brief trips to points along the western border at other times, it was decided to visit certain boreal districts in the eastern part of the State for their scientific interest, and to examine more thoroughly the southern and western counties from which injuries had been most frequently reported and where outbreaks were most likely to occur.

Accordingly, a collecting-trip by automobile was made to Mt. Desert, thence to the blueberry barrens at Cherryfield, and eastward to Machias; from there a day was spent in the peculiarly boreal district at Cutler and Trescott, going as far east as Lubec. Return to Orono was made over the "air-line" road from Wesley Corner. After a week of dull weather which was spent in working on the material at the Experiment Station, a trip was undertaken into the western part of the State, going via Skowhegan as far north as Bingham on the Jackman road, thence south to Norridgewock, Rumford Center, and Sebago Lake, returning by way of Highmoor Farm to Orono. Another week

of dull weather was spent at the Station, followed by a collecting-trip into southwestern Maine, touching at Popham Beach, Brunswick, Scarboro, and Wells, and inland to various points,—Standish, Limington, Kezar Falls, Porter, Lyman, Sanford. Rain then setting in, collecting was discontinued, but a two-day trip was later made by train to Eliot and Lebanon on Sept. 17 and 18. Six weeks in all were spent in the summer in gathering and working up the material, and at least two in preparation of the bulletin enclosed.

The use of the automobile for these trips proved very satisfactory, allowing many more points to be reached in a limited time than possible in any other way. Wherever it seemed worth while, stops were made, conditions examined, material secured, people interviewed, affected points ascertained and visited. In all cases instructions were given to apply to the Experiment Station for information regarding methods of control, if needed, and to report results thereto. In all, about 1400 miles were traversed in these trips within the State.

The conditions found may be stated as follows: grasshoppers (short-horned) were less numerous in 1920 than in either of the two preceding years (only one person reported to the contrary); and the relative scarcity was generally attributed, probably correctly, to the wet and cold spring. Several reports of a small amount of injury were received and investigated, in western Maine, to garden and field crops, and in one instance a young orchard of two-year-old apple-trees was found completely defoliated. This was leafing-out again when seen but a repetition of the occurrence would be serious.

Grasshoppers were most plentiful, in some cases actually "swarming," in sandy pastures in the western part of the State, e. g., near Farmington Falls, they were much less abundant in the central part of the State, and decidedly scarce in eastern counties though said to have been abundant and destructive two or three years ago.

The destructive species are: the Lesser Grasshopper (*Melanoplus atlanis*), the Red-legged Grasshopper (*Melanoplus femurrubrum*), the Two-striped Grasshopper (*Melanoplus bivittatus*), and the Clear-winged Grasshopper (*Camnula pellucida*); and this year they were usually most abundant and destructive in the

order named. All four are often found together in the same field unless it is decidedly dry, when *atlanis* and *pellucida* outnumber the other species. These four kinds have been responsible for many serious outbreaks in other parts of the country at various times and are destructive somewhere nearly every year. They are distributed over the entire State and require but two or three years of favorable conditions (usually droughty seasons) to multiply to such a degree as to become menacing.

Besides these, two other Short-horned Grasshoppers, the Meadow Slant-face (*Chorthippus curtipennis*) and the Pasture Grasshopper (*Orphulella speciosa*),—the first occurring over the entire State, the other only in the warmer portions,—though smaller, are often found in sufficient numbers to do much injury, but as yet have not been reported as being alone concerned in a serious outbreak. Added to these, the common large black field-cricket (*Gryllus assimilis*) and the small striped grass-cricket (*Nemobius fasciatus*) are often present in injurious numbers, together with two or three long-horned meadow-grasshoppers (*Conocephalus fasciatus*, *Con. brevipennis*, *Orchelimum vulgare*). The Dusky Grasshopper (*Encoptolophus sordidus*) is locally abundant in sandy fields in western Maine but matures so late in the season that it does not seem to do appreciable damage in spite of its numbers.

A considerable number of species new to the Experiment Station collection were secured.

At least one species was added to the known fauna of the State (*Arphia xanthoptera*); many additional data on distribution within the State were secured; also, extension of known ranges of other species, and additional localities for rare ones.

From the material collected on these trips, that secured through collecting done by assistants at Orono and elsewhere earlier in the summer, and much obtained in person in the spring in Massachusetts and New Hampshire (a special trip was made to Monadnock Mt. in June to get certain stages) it has been possible to make out characteristic recognition marks for the young of the most troublesome species and present them in the bulletin in a way which it is hoped will enable any observant person to identify these species with a little study. Incidentally, much information was secured regarding the life histories of other species.

Future work on the Order Orthoptera might well be undertaken when circumstances permit, in several lines of study, particularly these:

1st: study of the distinguishing characteristics and seasonal life history of the young stages of the other Orthoptera of the State, especially of *Melanoplus*, a genus which contains three of the more destructive species and of which seven others occur in the State.

2nd: study of the intra-State distribution of those Orthoptera which reach their northern or southern limit in Maine and of the factors controlling it. These factors are probably chiefly climatic and the results would bear on the cultivation of various crops.

3rd: study of the food habits, preferences, and amount of material consumed in the respective stages of life, especially by the more common species.

The bulletin comprises a brief introduction, a statement of the various families making up the order Orthoptera with illustrations of typical examples, their characteristics, mode of oviposition, the characters of the young, the development of the young and how to recognize the different stages (illustrated), tables of the chief types of injury caused by these insects, species chiefly responsible for injury to field crops, dangerous numbers, how to prevent injury, an illustrated key to the early stages of the destructive species, notes on injurious indoor species, recent immigrants into New England to be guarded against, a key to the families of adult Orthoptera, and a list of the Orthoptera of Maine enumerating 74 species which have been recorded from the State, with localities, dates, and notes on habits and abundance.

Albert P. Morse

Wellesley, Mass., Jan. 10, 1921.

CONTENTS.

	PAGE
Introduction	I
List of Six Families of Orthoptera (Grasshoppers and Related Insects) found in Maine.....	I
Grasshoppers with short "feelers" (Fig. 1).....	2
Grasshoppers with long "feelers" (Fig. 2).....	2
Crickets (Fig. 3).....	3
Walkingsticks (Fig. 4).....	4
Cockroaches (Fig. 5).....	4
Earwigs (Fig. 6).....	4
Characters of the Order.....	5
Egg-laying	5
Characteristics of the Young.....	6
Development of the Young.....	6
Food and Feeding-habits.....	8
Chief Types of Injury caused by Orthoptera.....	8
Species Chiefly Responsible for Injury to Field Crops.....	9
Prevention of Injury.....	10
Scale of Numbers per Square Yard with Reference to Need of Poisoning	12
Key to Aid in Identifying the Young of the Most Common and Destructive Species of Orthoptera found in Grassy Fields or Gardens in June and July.....	13
Adult Stage.....	17
Injurious Indoor Orthoptera (Crickets, Cockroaches, Earwigs)	18
Key to Families of Orthoptera of Maine. Adults.....	20
A List of the Orthoptera of the State of Maine.....	21
Author's Report	32